

Message Text

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TAGS: TSPA, UR, US

SUBJECT: US-USSR SPACE AGREEMENT (04.05.02) US PROPOSALS
FOR FLIGHT ON 1980 SOVIET BIOSATELLITE

FOR SCICOUN

1. PLEASE PASS THE FOLLOWING MESSAGE FROM WINTER TO
GUROVSKY WITH A COPY TO INTERCOSMOS. DETAILED PROPOSALS
AIRPOUCHED REGISTRY NUMBER 2943995.
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2. MAY 15, 1978 04.05.02

DR. NIKOLAI N. GUROVSKY
CHAIRMAN OF THE SOVIET WORKING GROUP
ON SPACE BIOLOGY AND MEDICINE
CHIEF OF THE DEPARTMENT OF SPACE
BIOLOGY AND MEDICINE
THIRD MAIN ADMINISTRATION
USSR MINISTRY OF HEALTH
MOSCOW, USSR

DEAR DR. GUROVSKY:

IN ACCORDANCE WITH ITEM 3.3 OF THE PROTOCOL OF THE EIGHTH MEETING OF THE JOINT US-USSR WORKING GROUP ON SPACE BIOLOGY AND MEDICINE, NOVEMBER 1977, I AM FORWARDING TO YOU BY MAIL COPIES OF FOURTEEN U.S. PROPOSALS FOR SCIENTIFIC INVESTIGATIONS ON THE 1980 BIOLOGICAL SATELLITE.

IN ORDER THAT YOU MIGHT RECEIVE BASIC INFORMATION AS SOON AS POSSIBLE, INCLUDING ABSTRACTS, TISSUE REQUESTS, AND TISSUE PREPARATION REQUIREMENTS, I HAVE SUMMARIZED BELOW SUCH INFORMATION FOR EACH OF THE 14 U.S. EXPERIMENT PROPOSALS. UPON RECEIPT OF THE PROPOSALS, IF YOU NOTE ANY APPARENT CONFLICT IN TISSUE REQUIREMENTS, THE REQUIREMENTS SPECIFIED IN THE FOLLOWING SUMMARIES SHOULD TAKE PRECEDENT:

1. TITLE: SERUM CALCIUM, PARATHYROID HORMONE, AND CALCITONIN IN 200-G MALE RATS SUBJECTED TO ORBITAL SPACEFLIGHT

PRINCIPAL INVESTIGATOR: HUNTER HEATH III, M.D., MAYO
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CLINIC AND MAYO MEDICAL SCHOOL/ROCHESTER, MINN.

ABSTRACT:

BEDREST OR IMMOBILIZATION IN EARTH GRAVITY CAUSES HYPERCALCEMIA AND BONE LOSS. PRELIMINARY EVIDENCE FROM PRIOR SPACE MISSIONS SUGGESTS THAT THE SAME PHENOMENA MAY OCCUR WHEN GRAVITATIONAL EFFECT IS ABOLISHED, EVEN WITHOUT IMMOBILITY. THE PRINCIPAL INVESTIGATOR PROPOSES TO EXAMINE SERUM AND URINE CALCIUM, SERUM PARATHYROID HORMONE AND CALCITONIN, AND BONE HISTOLOGY IN THE RATS USED FOR THE KOSMOS 80 SATELLITE EXPERIMENT. THE GOALS ARE TO LEARN WHETHER SPACEFLIGHT INDUCES HYPERCALCEMIA AND HYPERCALCIURIA IN THE ANIMALS; TO DETERMINE IF THE HOMEOSTATIC RESPONSES OF THE CALCIUM-REGULATING HORMONES ARE DISTURBED; AND TO CORRELATE THESE ENDOCRINE VARIABLES WITH BONE HISTOLOGY. THE IMPORTANCE OF SUCH KNOWLEDGE IS CLEAR: PROLONGED LIVING AT ZERO G COULD CAUSE MARKED SKELETAL WEAKENING; HYPERCALCEMIA COULD IMPAIR A NUMBER OF NEUROMUSCULAR FUNCTIONS; HYPERCALCIURIA MIGHT CAUSE RENAL STONES AND KIDNEY DAMAGE. UNDERSTANDING OF THESE PROBLEMS MUST PRECEDE THEIR CORRECTION, AND THESE ANIMAL STUDIES WILL PERMIT ACQUISITION OF DATA NOT OBTAINABLE FROM HUMAN SUBJECTS.

REQUIREMENTS:

MATERIAL: TWO (2) MILLILITERS OF SERUM IS REQUESTED FROM EACH FLIGHT RAT IN THE MUSCULOSKELETAL EXPERIMENT (10 RATS). IF AVAILABLE 0.5-1.0 ML OF URINE WOULD PERMIT THE INVESTI-

GATOR TO MEASURE CALCIUM AND CREATININE LEVELS. MID-SHAFT SECTIONS OF AT LEAST 1 FEMUR FROM EACH RAT ARE REQUESTED

FOR MICRORADIOGRAPHIC STUDIES TO DETERMINE UONE AREA AND PERCENT RESORPTION AND FORMATION SURFACES. THESE BONE SECTIONS SHOULD BE AT LEAST 1 CM IN LENGTH.

PREPARATION: SERUM SAMPLES SHOULD BE TAKEN AFTER FASTING
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RATS FOR APPROXIMATELY 8 HOURS. SERUM, URINE, AND BONE SAMPLES CAN ALL BE FROZEN TO THE U.S.

2. TITLE: QUANTITATIVE ANALYSIS OF SELECTED BONE PARAMETERS

PRINCIPAL INVESTIGATOR: EMILY MOREY HOLTON, PH.D.,
AMES RESEARCH CENTER

CO-INVESTIGATORS: DAVID J. BAYLINK, M.D.,
RUSSELL T. TURNER, PH.D., AMERICAN LAKE VETERAN'S ADMIN.
HOSPITAL AND UNIVERSITY OF WASHINGTON SCHOOL OF MEDICINE

ABSTRACT:

DATA PREVIOUSLY OBTAINED FROM THE TIBIAL DIAPHYSIS OF RATS FLOWN ABOARD COSMOS 782 (19.5 DAYS) OR 936 (18.5 DAYS) SUGGEST THAT NO GROSS CHANGE IN ENDOSTEAL BONE RESORPTION OCCURS DURING FLIGHT OR POSTFLIGHT; THAT MEAN PERIOSTEAL BONE FORMATION RATE DECREASES ABOUT 45 PERCENT AND IS NOT CORRECTED BY ARTIFICIAL GRAVITY (CENTRIFUGATION); THAT THE DECREASE IN FORMATION RATE MAY BE DUE, IN PART, TO A CESSATION OF BONE FORMATION WHICH OCCURS SOMETIME AFTER THE 11TH DAY OF FLIGHT AND CONTINUES UNTIL THE SECOND POST-FLIGHT DAY; THAT, ALTHOUGH ARTIFICIAL GRAVITY DID NOT CORRECT THE DEFECT IN PERIOSTEAL BONE FORMATION RATE DURING FLIGHT, IT APPEARS TO HASTEN THE RECOVERY FOLLOWING FLIGHT; AND THAT POSTFLIGHT, ALL FLIGHT RATS CORRECT THE DEFECT IS PERIOSTEAL BONE FORMATION RATE. FOLLOWING COSMOS 936, ABOUT A 30 PERCENT DECREASE IN FEMUR STIFFNESS WAS DETECTED IN THE FLIGHT ANIMALS BUT THE DEFECT WAS CORRECTED BY ARTIFICIAL GRAVITY. TO FURTHER DEFINE THESE FINDINGS, THE OBJECTIVES OF THIS PROPOSAL ARE TO DETERMINE THE EFFECT OF SPACEFLIGHT ON (1) PERIOSTEAL AND LONGITUDINAL BONE
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GROWTH IN WEIGHT-BEARING AND NON-WEIGHT-BEARING BONES, AND (2) OSTEOBLAST AND OSTEOCLAST ACTIVITY AT THE END OF FLIGHT, AND TO CONFIRM (1) ARREST LINE FORMATION, AND (2) ALTERED MATERIAL QUALITY (BREAKING STRENGTH IN TORSION) IMMEDIATELY FOLLOWING FLIGHT.

REQUIREMENTS:

MATERIAL: ONE TIBIA, ONE HUMERUS, ONE RADIUS AND BOTH FEMURS FROM EACH OF THE TEN RATS IN THE MUSCULOSKELETAL EXPERIMENT.

PREPARATION: IT IS PREFERRED THAT 5 OF THE 10 FLIGHT RATS BE SACRIFICED WITHIN 24 HOURS OF LANDING AND THE REMAINING 5 SACRIFICED AFTER RECOVERY PERIOD OF 5-25 DAYS. ALL RATS FOR THIS EXPERIMENT SHOULD BE INJECTED WITH DEMECLOCYCLINE, 1 MG/KG BODY WEIGHT, 3 DAYS PRIOR TO THE BEGINNING OF THE FLIGHT, DUE TO THE CONSTRAINTS OF THE FLIGHT SCHEDULE. TO CORRECT FOR THIS 3-DAY PERIOD, A BASAL GROUP OF 5-6 RATS SHOULD BE SACRIFICED AS CLOSE TO LAUNCH AS POSSIBLE. A SECOND INJECTION OF DEMECLOCYCLINE SHOULD BE GIVEN 4 DAYS AFTER LANDING TO ALL RATS IN THE READAPTATION GROUP. 3H-LYSINE (60-80 CI/MMOLE) SHOULD BE GIVEN TO ALL RATS WITHIN 24 HOURS OF SACRIFICE AT A DOSE OF 1 MICRON OF CI/KG BODY WEIGHT. 3H-LYSINE WILL FACILITATE THE IDENTIFICATION AND ACTIVITY OF CELL TYPES WITHIN BONE SECTIONS. ALL BONES SHOULD BE FROZEN ON DRY ICE SHORTLY AFTER SACRIFICE AND SHIPPED TO THE U.S. FROZEN.

3. TITLE: STRENGTH CHARACTERISTICS OF THE ISOLATED VERTEBRAL CENTRUM

PRINCIPAL INVESTIGATORS: LEON E. KAZARIAN, DR. ENG., AEROSPACE MED. RES. LAB., WRIGHT-PATTERSON AFB, OHIO, AND HENNING E. VON GIERKE, DR. ENG., AEROSPACE MED. RES. LAB., WRIGHT-PATTERSON AFB, OHIO

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ABSTRACT:

THE STRENGTH OF THE ISOLATED VERTEBRAL BODY WILL BE EVALUATED IN FLIGHT AND CONTROL RATS. A FACTORIAL EXPERIMENT WILL BE CONDUCTED IN AXIAL COMPRESSION AT THREE DIFFERENT STRAIN RATES. THE EFFECTS OF DISPLACEMENT AND VERTEBRAL BODY POSITION WILL BE DETERMINED USING THE FOLLOWING LOADING RATES (0.005334 M/MIN, 0.5334 M/MIN, AND 53.34 M/MIN). FOUR DEPENDENT VARIABLES WILL BE EXTRACTED DIRECTLY FROM THE TEST CURVES AND WILL HAVE UNITS OF LOAD OR DEFORMATION OR COMBINATIONS THEREOF. THESE FOUR VARIABLES ARE: ULTIMATE LOAD, DEFORMATION TO ULTIMATE LOAD, STIFFNESS, AND ENERGY TO ULTIMATE LOAD. THE INDEPENDENT VARIABLES ARE ULTIMATE ENGINEERING STRAIN AND ELASTIC MODULES.

MATERIAL: SPINAL COLUMN FROM THE THORACIC TO THE SACRAL REGION FROM EACH OF TEN FLIGHT RATS AND GROUND SYNCHRONOUS AND VIVARIUM CONTROLS.

PREPARATION: THREE DAYS BEFORE LAUNCH ANTERIOR-POSTERIOR AND LATERAL RADIOGRAPHS SHOULD BE TAKEN OF CONTROL AND EXPERIMENTAL ANIMALS. SIMILAR RADIOGRAPHS SHOULD BE TAKEN AGAIN WITHIN 36 HOURS OF RECOVERY. SPINAL COLUMNS SHOULD

BE REMOVED EN MASSE AND FROZEN IN DRY ICE FOR RETURN TO THE U.S.

4. TITLE: DENTINOGENESIS AND OSTEOGENESIS IN THE RAT MANDIBLE DURING SPACEFLIGHT

PRINCIPAL INVESTIGATOR: DAVID J. SIMMONS, PH.D.,
WASHINGTON UNIVERSITY/ST. LOUIS

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ABSTRACT:

IT IS PROPOSED TO EXPLORE THE EFFECTS OF SPACEFLIGHT ON THE PHYSIOLOGY OF TEETH AND THEIR SUPPORTING BONY STRUCTURES IN

THE JAWS OF RATS. THE STUDIES WILL BE CAPABLE OF MEASURING THE PROLIFERATIVE POTENTIAL OF THE PROGENITOR CELL POPULATIONS FOR OSTEOBLASTS AND ODONTOBLASTS, THE RATES OF OSTEOGENESIS AND DENTINOGENESIS (TETRACYCLINE LABELING), AND THE QUALITY AND QUANTITY OF MICROSCOPIC MINERALIZATION. THE ANALYSES OF THE MINERALIZED FRACTION OF THE BONE AND DENTAL STRUCTURES WILL ALSO PROVIDE DATA RELATIVE TO THE IMPACT OF SPACEFLIGHT ON CIRCADIAN, ULTRADIAN, AND INFRA-DIAN COMPONENTS OF BONE AND TOOTH PHYSIOLOGY.

REQUIREMENTS:

MATERIAL: MANDIBLES OF 10 FLIGHT RATS AND 20 VIVARIUM RATS.

PREPARATION:

- (1) AT 1 DAY PREFLIGHT, RIGHT LOWER INCISOR OF EACH RAT WILL BE NOTCHED BY USE OF A FILE.
- (2) AT SAME TIME, ANIMALS WILL BE INJECTED WITH DEMETHYL-CHLORTETRACYCLINE.
- (3) AT 1 DAY POSTFLIGHT, 6 CONTROL AND 5 FLIGHT RATS WILL BE INJECTED WITH TRITIATED THYMIDINE AND SACRIFICED SHORTLY AFTERWARD. SAMPLES PREPARED AS BELOW.
- (4) AT 4 DAYS POSTFLIGHT, REMAINING RATS WILL BE INJECTED WITH OXYTETRACYCLINE.
- (5) AT 7 DAYS POSTFLIGHT, THE RATS WILL BE INJECTED WITH TRITIATED THYMIDINE AND SACRIFICED AN HOUR LATER.
- (6) SAMPLES PREPARED AFTER SACRIFICE BY EXCISING THE MANDIBLES, CLEANING THEM OF SOFT TISSUE, AND FIXING THE RIGHT MANDIBLE IN 100 PERCENT ETHYL ALCOHOL, THE LEFT IN 10 PERCENT FORMALIN.

5. TITLE: AUTOMATIC ANALYSIS OF MUSCLE FIBERS FROM RATS

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SUBJECTED TO SPACEFLIGHT (KOSMOS 1980)

PRINCIPAL INVESTIGATOR: K. R. CASTLEMAN, PH.D., JET
PROPULSION LABORATORY

CO-INVESTIGATORS: L. A. CHUI, M.D., J.P. VAN DER MEULEN,
M.D., USC MEDICAL CENTER, LOS ANGELES, CA

ABSTRACT:

AN EXPERIMENT IS PLANNED FOR THE KOSMOS 1980 BIOSATELLITE MISSION TO QUANTIFY THE FIBER SIZE AND FIBER TYPE CHANGES WHICH OCCUR IN THREE MUSCLES OF RATS SUBJECTED TO WEIGHT-LESSNESS AND HYPOKINESIS IN SPACEFLIGHT. THE PROPORTION OF "FAST" AND "SLOW" FIBERS WILL BE TABULATED AND FIBER SIZE DISTRIBUTION CURVES PLOTTED FOR THE SOLEUS, GASTROCNEMIUM, AND PLATARIS MUSCLES. THE MUSCLES WILL BE SECTIONED AND STAINED ACCORDING TO FOUR DIFFERENT HISTOCHEMICAL REACTIONS. THE QUANTITATIVE ANALYSIS WILL BE PERFORMED WITH COMPUTER IMAGE PROCESSING TECHNIQUES IN THE MEDICAL IMAGE ANALYSIS FACILITY AT JPL. WE ANTICIPATE FINDING LOSS OF FIBER SIZE IN THE FLIGHT ANIMALS DUE TO DISUSE ATROPHY AND SOME CONVERSION OF FIBERS FROM SLOW TO FAST OR VICE VERSA. THE QUANTITATIVE RESULTS WILL SHED LIGHT ON THE MECHANISM BY WHICH MUSCLES ADAPT TO THE LACK OF GRAVITY.

REQUIREMENTS:

MATERIAL: REPRESENTATIVES OF "FAST," "SLOW," AND "MIXED" FAST/SLOW MUSCLE TYPES ARE REQUESTED (I.E., FAST-PLANTARIS, SLOW-SOLEUS, MIXED-GASTROCNEMIUM). THE ENTIRE MUSCLE OF EACH TYPE IS REQUIRED.

PREPARATION: MUSCLES SHOULD BE EXCISED AND FROZEN IN LIQUID NITROGEN AS SOON AFTER SACRIFICE AS POSSIBLE.

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MUSCLES WILL BE PACKED IN DRY ICE AND SHIPPED TO THE U.S. FOR ANALYSIS.

6. TITLE: BIOCHEMICAL INDICES OF SKELETAL MUSCLE AND CARDIAC MUSCLE FUNCTION FOLLOWING ZERO-GRAVITY EXPOSURE

PRINCIPAL INVESTIGATOR: RUSSELL T. DOWELL, PH.D.,
UNIVERSITY OF OKLAHOMA

CO-PRINCIPAL INVESTIGATORS: KENNETH M. BALDWIN, PH.D.,
UNIVERSITY OF OKLAHOMA, AND HAROLD SANDLER, M.D., AMES
RESEARCH CENTER

ABSTRACT:

RELATIVELY LONG-TERM EXPOSURE TO A ZERO-GRAVITY ENVIRONMENT RESULTS IN DEMONSTRABLE ALTERATIONS IN BOTH SKELETAL MUSCLE AND CARDIOVASCULAR FUNCTIONS. IN ORDER TO PREVENT OR MINIMIZE POTENTIAL ZERO-GRAVITY INDUCED DECREMENTS IN MUSCLE AND CARDIOVASCULAR PERFORMANCE, THE MORPHOLOGICAL AND BIOCHEMICAL BASES FOR THESE FUNCTIONAL DISTURB-

ANCES MUST BE IDENTIFIED. MORE SPECIFICALLY, SOVIET STUDIES FOLLOWING THE COSMOS-605 MISSION HAVE IDENTIFIED A POTENTIAL SKELETAL MUSCLE LESION ASSOCIATED WITH EXPOSURE TO A ZERO-GRAVITY ENVIRONMENT. HOWEVER, THE HISTOCHEMICAL EVALUATIONS UTILIZED ARE QUALITATIVE IN NATURE AND PROVIDE LITTLE DIRECT CORRELATION RELATED TO SKELETAL MUSCLE FUNCTION SINCE THE CONTRACTILE PROTEINS WERE NOT EXAMINED. IT IS ALSO NECESSARY TO EXAMINE THE RELATIVE INVOLVEMENT OF DIFFERENT SKELETAL MUSCLE FIBER TYPES IN ORDER TO DETERMINE THE POTENTIAL EFFECT OF DEGENERATIVE CHANGES ON THOSE MUSCLES NORMALLY UTILIZED FOR MOTOR ACTIVITIES. THE QUESTION OF WHETHER DEGENERATIVE CHANGES COMPARABLE TO THOSE OBSERVED IN POSTFLIGHT SKELETAL MUSCLE MAY ALSO OCCUR IN CARDIAC MUSCLE REMAINS TO BE ANSWERED. THEREFORE, QUANTITATIVE BIOCHEMICAL ANALYSES OF SKELETAL MUSCLE AND UNCLASSIFIED

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CARDIAC MUSCLE SEEM WARRANTED TO DETERMINE THE INFLUENCE OF A ZERO-GRAVITY ENVIRONMENT ON MUSCLE STRUCTURE AND FUNCTION.

REQUIREMENTS:

MATERIAL: EXPERIMENTAL ANIMALS FOR INVESTIGATION WOULD BE OBTAINED FROM COSMOS 80 MISSION PLANNED EXPERIMENTS: TOTAL BODY COMPOSITION RATS AND MUSCULOSKELETAL STUDIES WITH RATS. ANIMALS FROM BOTH THE "SYNCHRONOUS CONTROL" AND VIVARIUM CONTROL GROUPS WOULD SERVE AS APPROPRIATE CONTROLS FOR THE EXPERIMENTAL ANIMALS.

PREPARATION: AT THE TIME OF SACRIFICE, THE TISSUES INDICATED BELOW WOULD BE RAPIDLY REMOVED FROM THE ANIMALS, WEIGHED, AND FROZEN FOR SUBSEQUENT BIOCHEMICAL ANALYSES.

1. SKELETAL MUSCLE-THE ENTIRE MUSCLE OR PORTIONS OF MUSCLE FROM THE (A) SOLEUS, (B) QUADRICEPS, AND (C) GASTROCNEMIUS SHOULD BE REMOVED FROM EITHER HINDLIMB OF THE RATS.
2. CARDIAC MUSCLE-RIGHT AND LEFT ATRIA, EXTRANEIOUS TISSUE, AND THE REMAINING GREAT VESSELS ARE REQUESTED AND THE REMAINING PORTION OF THE HEART IS SEPARATED INTO RIGHT VENTRICULAR FREE WALL AND LEFT VENTRICLE PLUS INTERVENTRICULAR SEPTUM. THESE SAMPLES ARE THEN WEIGHED INDIVIDUALLY AND FROZEN. THE RIGHT VENTRICLE AND LEFT VENTRICLE PLUS SEPTUM WILL BE ANALYZED SEPARATELY.

7. TITLE: STUDIES OF SPECIFIC HEPATIC ENZYMES INVOLVED IN

THE CONVERSION OF CARBOHYDRATES TO LIPID IN RATS EXPOSED TO
PROLONGED SPACEFLIGHT

PRINCIPAL INVESTIGATOR: SAMUEL ABRAHAM, PH.D., BRUCE LYON
MEMORIAL RES. LAB., CHILDREN'S HOSPITAL MEDICAL
CENTER/OAKLAND
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CO-PRINCIPAL INVESTIGATOR: HAROLD P. KLEIN, PH.D.,
AMES RESEARCH CENTER

ABSTRACT:

AN EXPERIMENT IS PROPOSED TO 1) DETERMINE THE EFFECTS OF
SPACEFLIGHT ON BASIC PHYSIOLOGICAL PROCESSES IN RATS
EXPOSED TO PROLONGED SPACEFLIGHT BY EXAMINING THE COMPETI-
TION IN THE ACTIVITIES OF HEPATIC ENZYMES INVOLVED IN THE
SYNTHESIS OF NEUTRAL LIPIDS AND OF PHOSPHOLIPIDS; 2)
VERIFY SPECIFIC CHANGES IN ACTIVITIES OF LIVER ENZYMES
CONCERNED WITH THE CONVERSION OF CARBOHYDRATES TO LIPIDS
IN RATS FROM THE COSMOS 936 FLIGHT; AND 3) EXAMINE THE
LIPID COMPOSITION OF BLOOD AND OF LIVER FROM THESE RATS IN
ORDER TO EXPLAIN ALTERATIONS OBSERVED IN HEPATIC ENZYME
ACTIVITIES AND COMPOSITION.

REQUIREMENTS:

MATERIAL: A LIVER SAMPLE (4 GM) IS REQUESTED FROM EACH OF
THE 10 RATS IN THE MUSCULOSKELETAL EXPERIMENT. THE
LIVER IS TO BE PROCESSED IN THE SAME MANNER USED FOR
EXPERIMENT K204 DURING THE COSMOS 936 MISSION. IN ADDITION,
BLOOD SAMPLES ARE REQUESTED AT THE TIME OF SACRIFICE FROM
THE SAME RATS FROM WHICH LIVER SAMPLES ARE TAKEN. IF
POSSIBLE, SAMPLES FROM RATS ALLOWED TO READAPT TO TERRES-
TRIAL GRAVITY WOULD BE VALUABLE FOR COMPARISON TO SAMPLES
FROM RATS SACRIFICED SOON AFTER SPACECRAFT RECOVERY.

PREPARATION: PROCEDURES USED FOR COSMOS 936 EXPERIMENT
K204 WILL AGAIN BE UTILIZED FOR LIVER SAMPLES.

BLOOD SAMPLES: APPROXIMATELY 0.5 ML OF SERUM, OBTAINED
FROM THE BLOOD SAMPLES, SHOULD BE FROZEN TO -80C AND
SHIPPED TO THE U.S.

8. TITLE: EFFECT OF WEIGHTLESSNESS ON RED BLOOD CELL
PRODUCTION IN RATS
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PRINCIPAL INVESTIGATOR: HENRY A. LEON, PH.D., AMES
RESEARCH CENTER

CO-PRINCIPAL INVESTIGATOR:: STEPHEN A. LANDAW, M.D., PH.D.,
VETERAN'S ADMINISTRATION HOSPITAL/SYRACUSE, NY

ABSTRACT:

IN TWO PREVIOUS COSMOS FLIGHTS, WE HAVE DEMONSTRATED A THREEFOLD INCREASE IN HEMOLYSIS RATE IN RATS SUBJECTED TO SPACEFLIGHT. WITH MODIFICATIONS, THE TECHNIQUE WE HAVE EMPLOYED FOR THE DETERMINATION OF RANDOM HEMOLYSIS AND OTHER RED CELL SURVIVAL PARAMETERS CAN BE USED TO DETERMINE RED CELL PRODUCTION OCCURRING DURING A DISCRETE TIME PERIOD; WE PRESENT THIS PROPOSAL TO MEASURE RED CELL PRODUCTION CHANGES IN RATS RESULTING FROM SPACEFLIGHT.

TWO EXPERIMENTAL APPROACHES ARE PROPOSED: THE FIRST APPROACH WOULD RESULT IN A MEASURE OF RED CELL PRODUCTION REPRESENTATIVE OF THE END OF THE FLIGHT. THE SECOND APPROACH WOULD OBTAIN MEASUREMENTS OF PRODUCTION REPRESENTATIVE OF TWO DISTINCT TIME PERIODS DURING FLIGHT (DAYS 3 AND 10, FOR EXAMPLE).

REQUIREMENTS:

APPROACH NUMBER 1 (POSTFLIGHT INJECTION): TEN FLIGHT RATS, 10 SYNCHRONOUS CONTROL RATS, 10 VIVARIUM CONTROL RATS.

APPROACH NUMBER 2 (IN-FLIGHT INJECTION): SAME NUMBER OF RATS AS APPROACH NUMBER 1.

IN BOTH APPROACHES, BREATH SAMPLES WOULD BE REQUIRED FOR 80 DAYS POSTFLIGHT (POSTFLIGHT INJECTIONS) OR 65 DAYS
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POSTFLIGHT (IN-FLIGHT INJECTION). SAMPLING TECHNIQUES WILL BE SIMILAR TO THOSE USED FOR COSMOS 782 AND 936 RBC EXPERIMENTS.

PREPARATION:

APPROACH NUMBER 1 (POSTFLIGHT INJECTION): IF 10 FLIGHT RATS ARE AVAILABLE, 5 WOULD BE INJECTED WITH 2-14C GLYCINE (500 MICRONS OF CI/KG) WITHIN 12 HOURS POSTFLIGHT AND 5 INJECTED 7 DAYS AFTER LANDING. TEN SYNCHRONOUS CONTROL AND 10 VIVARIUM CONTROL ANIMALS WOULD BE TREATED SIMILARLY.

APPROACH NUMBER 2 (IN-FLIGHT INJECTION): IF 10 FLIGHT RATS ARE AVAILABLE, THEY WOULD BE IMPLANTED I.P. WITH OSMOTICALLY DRIVEN PUMPS APPROXIMATELY 25 DAYS PREFLIGHT AND PUMPS ADJUSTED SO THAT 5 RATS WOULD RECEIVE 14C-GLYCINE APPROXIMATELY 3 DAYS AFTER LAUNCH AND THE OTHER 5 RATS RECEIVE IT 10 DAYS AFTER LAUNCH.

9. TITLE: ANALYSIS OF ENZYME DEVELOPMENT IN LIVER, KIDNEY, AND BRAIN OF FETAL OR NEONATAL RATS THAT HAVE BEEN EXPOSED TO SPACEFLIGHT

PRINCIPAL INVESTIGATOR: SAMUEL ABRAHAM, PH.D.,
BRUCE LYON MEMORIAL RES. LAB., CHILDREN'S HOSPITAL MEDICAL
CENTER/OAKLAND

CO-PRINCIPAL INVESTIGATOR: HAROLD P. KLEIN, PH.D.,
AMES RESEARCH CENTER

ABSTRACT:

THE OBJECTIVE OF THIS PROPOSED EXPERIMENT IS TO DETERMINE
THE EFFECTS OF SPACEFLIGHT ON THE EMBRYOLOGICAL DEVELOPMENT
OF VARIOUS ENZYMES IN FETAL OR NEONATAL LIVER, KIDNEY, AND
BRAIN. DURING MAMMALIAN DEVELOPMENT, GREAT CHANGES OCCUR
IN THE NUTRITIONAL AND HORMONAL ENVIRONMENT OF THE YOUNG.
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SUCH CHANGES, WHEN MEASURED IN THE FETAL, NEONATAL, SUCK-
LING, AND POSTWEANING STAGES OF DEVELOPMENT, HAVE INDICATED
SPECIFIC PATTERNS IN DIFFERENT MAMMALIAN TISSUES. THE
ACTIVITY OF AN ENZYME IN A TISSUE PROVIDES A VERY SENSITIVE
PHYSIOLOGICAL REFERENCE POINT BY WHICH THE SIGNIFICANCE OF
DEVELOPMENTAL CHANGES CAN BE JUDGED. TISSUES WHICH
SYNTHESIZE HORMONES, DETOXIFY WASTE PRODUCTS, OR PROVIDE
SPECIAL ENERGY SOURCES MUST POSSESS SPECIFIC ENZYMES FOR
SUCH METABOLIC FUNCTIONS. THUS A STUDY OF ENZYME SYSTEMS
AND A DETERMINATION OF THE DEVELOPMENTAL STAGE AT WHICH
THEY EMERGED, IN ONE TISSUE AS OPPOSED TO ANOTHER, PIN-
POINTS CRUCIAL MOMENTS OF BIOCHEMICAL DIFFERENTIATION.

REQUIREMENTS:

MATERIAL: SAMPLES OF AT LEAST 100 MG ARE REQUESTED OF
BRAIN, LIVER, KIDNEY, AND OTHER TISSUES IF AVAILABLE,
E.G., SMALL INTESTINE, LUNG, ETC. THE GREATER THE SAMPLE
WEIGHT, THE GREATER THE NUMBER OF ENZYMES IT WILL BE
POSSIBLE TO ASSAY. SAMPLES OF TISSUE ARE ALSO REQUESTED
FROM THE PREGNANT FEMALE OR MOTHER. IF PREGNANT FEMALES
ARE ALLOWED TO GIVE BIRTH, WE WOULD PREFER THAT THE
SACRIFICE OF THE PUPS BE STAGGERED, E.G., SACRIFICED AT
BIRTH 3, 5, 7, AND 20 OR MORE DAYS OLD.

PREPARATION: TISSUES ARE WEIGHED, HOMOGENIZED, AND
CENTRIFUGALLY SEPARATED INTO INDIVIDUAL FRACTIONS AS WAS
DONE FOR EXPERIMENT K204 DURING THE COSMOS 936 MISSION.
THE VARIOUS FRACTIONS WILL BE SHIPPED FROZEN BACK TO THE
U.S.

10. TITLE: FETAL AND NEONATAL RAT BONE AND JOINT
DEVELOPMENT FOLLOWING INUTERO SPACEFLIGHT

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PRINCIPAL INVESTIGATOR: E. M. HOLTON, PH.D.,
AMES RESEARCH CENTER

CO-INVESTIGATOR: E. E. SABELMAN, PH.D.,
AMES RESEARCH CENTER

ABSTRACT:

AN EMBRYOLOGICAL EXPERIMENT IS PLANNED FOR THE KOSMOS 1980 BIOSATELLITE IN WHICH FEMALE RATS WILL BE MATED FOLLOWING THE TENTH DAY OF A 20-22 DAY ORBITAL FLIGHT. SPECIMENS OF

FETAL AND/OR NEONATAL HINDLIMB BONES WILL BE OBTAINED AT 2-DAY INTERVALS AFTER THE 14TH GESTATION DAY. BONE, JOINT, AND TENDON DEVELOPMENT WILL BE STUDIED BY LIGHT MICROSCOPY AND SEM OF STRUCTURES WHOSE MORPHOLOGY IS KNOWN TO BE SENSITIVE TO MECHANICAL STRESS AND FUNCTIONAL UTILIZATION. THESE INCLUDE DIMENSIONAL FEATURES OF THE TIBIA AND FIBULA, STRUCTURE OF EPIPHYSEAL AND ARTICULAR CARTILAGE, ORIENTATION OF TENDONS AND LIGAMENTS RELATIVE TO BONE, AND LOCATION OF BONE REMODELING MEASURED USING INJECTED LABELS.

REQUIREMENTS:

MATERIAL: AT LEAST 1 PREGNANT FLIGHT RAT IS REQUIRED AND AT LEAST 1 PUP FROM THIS RAT SACRIFICED AT BIRTH AND AT APPROXIMATELY 2-DAY INTERVALS THEREAFTER. THE FOLLOWING SPECIMENS ARE REQUESTED FROM EACH PUP: DISTAL FEMUR, PATELLA, INTACT KNEE JOINT, TIBIA, FIBULA, TALUS, AND CALCANEUS AND 2-3 MM OF ATTACHED TENDONS FROM AT LEAST ONE LIMB OF EACH ANIMAL. ADDITIONAL INFORMATION COULD BE OBTAINED BY EXAMINATION OF THE CROSS-SECTIONAL AREA OF LIMB MUSCULATURE AND THE ARTICULAR SURFACES OF THE HIP JOINT, IF THESE WERE LEFT INTACT.

PREPARATION: APPROXIMATELY 2 DAYS BEFORE SACRIFICE, DECILOMYCIN, LEAD ACETATE, OR 45 CA ARE INJECTED INTO THE PUPS OR PREGNANT RAT. 3H-GLYCINE OR 3H-PROLINE IS ALSO UNCLASSIFIED

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INJECTED 2 DAYS BEFORE SACRIFICE. AFTER SACRIFICE THE ENTIRE HINDLIMB IS REMOVED AND PLACED IN BOUIN'S FIXATIVE. DISSECTION WILL BE PERFORMED IN THE U.S.

11. TITLE: ANALYSIS OF THE CRANIAL SENSORY DEVELOPMENT IN QUAIL AND RAT EMBRYOS DERIVED FROM JOINT US/USSR BIOLOGICAL SATELLITE PROGRAM COSMOS 1980 MISSION

PRINCIPAL INVESTIGATOR: J. RICHARD KEEFE, PH.D.

ABSTRACT:

THE JOINT US/USSR COSMOS 1980 MISSION OFFERS A UNIQUE FIRST-TIME OPPORTUNITY TO STUDY THE PROCESSES OF MAMMALIAN FERTILIZATION, IMPLANTATION, PLACENTATION, AND

EMBRYONIC DEVELOPMENT UNDER THE UNUSUAL ENVIRONMENTAL EXPOSURES FOUND IN SPACEFLIGHT. WHAT IS OF PRIMARY CONCERN IS THAT THE FEMALE PHYSIOLOGY DOES NOT ACCENTUATE THE ALTERATIONS IN BODY PHYSIOLOGY DEMONSTRATED IN ALL MALE ASTRONAUTS DURING SPACE EXPOSURE AND THAT THE PHYSIOLOGICAL ALTERATIONS NORMALLY OBSERVED IN PREGNANCY WILL NOT BECOME ADDITIONALLY DISABLING. SINCE WE WILL BE

UNABLE TO SEPARATE THESE FACTORS IN THE PRESENT DESIGN, THE COMPARATIVE EFFECTS UPON THE DEVELOPING AVIAN EMBRYO

(JAPANESE QUAIL) WILL BE MOST HELPFUL. PARTICULAR ATTENTION WILL BE PAID TO THE PERIPHERAL VESTIBULAR SYSTEM IN SPACE-CONCEIVED AND GESTATED MAMMALS, RETINAL PROLIF- ERATION AND DIFFERENTIATION AS AN INDEX OF THE PHYSIOLOG- ICAL STATUS OF THE FETAL CARDIOVASCULAR SYSTEM, AND THE REPRODUCTIVE ORGANS.

REQUIREMENTS:

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MATERIAL: EXPERIMENTAL MATERIALS ARE TO BE DERIVED FROM JAPANESE QUAIL EMBRYOS AND RAT FETUSES/NEWBORNS, THOSE RECOVERED FROM FLIGHT AND APPROPRIATE SYNCHRONOUS AND VIVARIUM CONTROLS.

PREPARATION: SAMPLES OF THE PREGNANT RATS AND JAPANESE QUAIL WILL BE INJECTED WITH TRITIATED THYMIDINE AS SOON AFTER RECOVERY AS IS FEASIBLE (BUT NO LATER THAN 48 HOURS) AND SACRIFICED FOLLOWING 3 HOURS OF EXPOSURE. TISSUE SAMPLES FROM THE FETUSES AND QUAIL EMBRYOS WILL BE OBTAINED BY DECAPITATION INTO AN OSMOTICALLY BALANCED TRIALDEHYDE FIXATIVE CHILLED TO 4 DEGREES CENTIGRADE.

12. TITLE: LONG-TERM EFFECTS OF WEIGHTLESSNESS ON A BIOLOGICAL SYSTEM

PRINCIPAL INVESTIGATOR: RALPH BAKER, PH.D., COLORADO STATE UNIVERSITY

CO-PRINCIPAL INVESTIGATORS: JOHN HENDRIX, PH.D., COLORADO STATE UNIVERSITY, AND CHARLES R. CURTIS, PH.D., THE UNIVERSITY OF DELAWARE

ABSTRACT:

A SYSTEM INVOLVING THE DEVELOPMENT OF TUMORS OF CROWN GALL ON CARROTS HAS PROVED TO BE A USEFUL TOOL IN DETERMINING THE EFFECTS OF GRAVITY ON BIOLOGICAL SYSTEMS. GRAVITY TREATMENTS INDUCE CHANGES IN TUMOR SIZES AND WEIGHTS, CELLULAR DEVELOPMENT, ENZYME ACTIVITY; ISOZYME PATTERNS, AND RESIDUAL CARBOHYDRATES IN THE SUPPORTING CARROT DISC. RESULTS OBTAINED FROM KOSMOS 782 INDICATED THAT GRAVITY

COMPENSATION ON EARTH DID NOT CONSISTENTLY SIMULATE THE
INFLUENCE OF WEIGHTLESS CONDITIONS IN THE SPACE ENVIRONMENT.
WE PROPOSE TO ORBIT THE EXPERIMENT IN KOSMOS 80,

INCORPORATING REFINED AND MORE PRECISE METHODS AND IMPROVED
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MATERIALS. IN ADDITION, HYPOTHESES EXPLAINING UNPREDICTED
RESPONSES OBSERVED IN KOSMOS 782 WILL BE TESTED.

REQUIREMENTS:

MATERIAL: CARROT TISSUE (ROOT SECTIONS) INOCULATED
WITH CROWN GALL BACTERIA.

PREPARATION: TISSUE WILL BE CONTAINED IN U.S.-DEDICATED
VOLUME.

13. TITLE: CELLS, EMBRYOS, AND DEVELOPMENT IN SPACE:
A PROPOSAL FOR AN EXPERIMENT FOR JOINT US/USSR BIOLOGICAL
SATELLITE PROGRAM KOSMOS 80 MISSION

PRINCIPAL INVESTIGATOR: ABRAHAM D. KRIKORIAN, PH.D.,
STATE UNIVERSITY OF NEW YORK AT STONY BROOK AND
FREDERICK C. STEWARD, PH.D., STATE UNIVERSITY OF
NEW YORK AT STONY BROOK

ABSTRACT:

THE FIRST OBJECTIVE OF THE KOSMOS 80 FLIGHT EXPERIMENT IS
TO CONFIRM THE CONCLUSION DRAWN FROM OUR STUDIES OF
MATERIAL FLOWN ON KOSMOS 782 THAT A COMPLETE SEXUALLY
REPRODUCED HIGHER PLANT CAN ACHIEVE FULL COMPLEXITY FROM
SINGLE CELLS (IN THIS CASE SOMATIC CELLS) IN THE WEIGHTLESS
CONDITIONS OF SPACE. A SECOND TOTALLY NEW OBJECTIVE HAS
SIGNIFICANCE FOR PLANT MORPHOGENESIS IN GENERAL AND, MORE
SPECIFICALLY, FOR THE CONTINUED GROWTH OF ANY HIGHER PLANT
UNDER SPACE CONDITIONS. WE SHOWED WITH OUR KOSMOS 782
EXPERIMENT THAT CULTURED TOTIPOTENT CELLS OF CARROT CAN
GIVE RISE TO EMBRYOS WITH WELL-DEVELOPED ROOTS BUT WITH
MINIMALLY DEVELOPED SHOOTS AT NEAR ZERO G. WE SUGGESTED
THAT MUCH OF THE EMBRYONIC DEVELOPMENT FROM THE CELLS
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OCCURRED DURING THE FIRST 14 DAYS OF FLIGHT. BUT WE COULD
NOT THEN TEST WHETHER THE WEIGHTLESS SPACE ENVIRONMENT
COULD SUPPORT THE FURTHER DEVELOPMENT OF LEAFY SHOOTS FROM
ALREADY ORGANIZED LATER EMBRYONIC STAGES. OUR SECOND
OBJECTIVE IS TO ESTABLISH WHETHER CONTINUED DEVELOPMENT
OF THE LEAFY SHOOT IS SENSITIVE TO ZERO-G CONDITIONS.

REQUIREMENTS:

MATERIAL: TOTIPOTENT CARROT CELLS AND EMBRYOS IN DIFFERING STAGES OF DEVELOPMENT.

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PREPARATION: CELLS AND EMBRYOS WILL BE ARRANGED IN PETRI DISHES CONTAINED IN THE U.S.-DEDICATED VOLUME.

14. TITLE: RADIATION DOSIMETRY-SHIELDING EXPERIMENT

U.S. PRINCIPAL INVESTIGATOR: E. V. BENTON, PH.D.,

UNIVERSITY OF SAN FRANCISCO

CO-INVESTIGATORS: R. M. CASSOU, A. L. FRANK, R. P. HENKE,
D. D. PETERSON, UNIVERSITY OF SAN FRANCISCO

USSR PRINCIPAL INVESTIGATOR: E. E. KOVALEV, INSTITUTE
OF BIOMEDICAL PROBLEMS/MOSCOW

ABSTRACT:

RESEARCH IS PROPOSED TO OBTAIN RELEVANT DOSIMETRIC INFORMATION OF THE SPACE RADIATION ENVIRONMENT INSIDE AND (IF POSSIBLE) OUTSIDE THE SPACECRAFT WITH A SPECIAL EMPHASIS ON RADIATION COMPONENTS WHICH ARE POORLY KNOWN AND WHICH INCLUDE THE PORTION OF THE HZE PARTICLE SPECTRUM AROUND LET EQUALS 100 KEV/MICRON-M, THE PROTON-INDUCED HIGH-LET RECOILS, AND THE NEUTRON DOSE AND SPECTRUM. MEASUREMENT OF THESE COMPONENTS IN THE KOSMOS 80 MISSION WILL BE GREATLY FACILITATED OVER PAST INVESTIGATIONS AS UNCLASSIFIED

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A RESULT OF THE RECENT DEVELOPMENT OF A MORE SENSITIVE PLASTIC MATERIAL FOR USE AS A NUCLEAR TRACK DETECTOR. THIS NEW PLASTIC DETECTOR IS THE FIRST ONE CAPABLE OF RECORD RECORDING RELATIVISTIC FE NUCLEI AS WELL AS OTHER LIGHT FAST NUCLEI AND MAKES THE MEASUREMENT OF LET VALUES WELL BELOW 100/KEV/MICRON-M POSSIBLE FOR THE FIRST TIME.

IN ADDITION TO THESE MEASUREMENTS, AN ATTEMPT WILL BE MADE TO DIRECTLY MEASURE THE EFFECTIVENESS OF ELECTROSTATIC AND DIELECTRIC SHIELDING METHODS WHICH OFFER SIGNIFICANT WEIGHT SAVINGS AS A MEANS OF EFFECTIVE SHIELDING IN OR NEAR THE GEOSYNCHRONOUS ORBITS.

OF THE SEVERAL AREAS PROPOSED FOR INVESTIGATION, THE EMPHASIS WILL BE PLACED ON THOSE WHICH WILL BE MUTUALLY AGREED ON IN FURTHER DISCUSSIONS BETWEEN THE US AND USSR INVESTIGATORS.

REQUIREMENTS:

MATERIAL: IT IS PROPOSED THAT: A SET OF PASSIVE RADIATION DETECTORS BE PLACED IN ONE OF THE TWO VOLUMES ALLOCATED TO THE US, WITH ADDITIONAL PASSIVE DETECTORS LOCATED

OUTSIDE THE SPACECRAFT AND AT THE SIDE OF THE RADIATION SHIELDING EXPERIMENT. THE DETAILS OF DETECTOR CONSTRUCTION WILL BE WORKED OUT LATER, BUT WILL BE DESIGNED TO MEASURE RECOILS, HZE PARTICLES, AND NEUTRONS.

ELECTROSTATIC AND DIELECTRIC SHIELDING: MEASUREMENTS OF THE RADIATION LEVELS IN THE VICINITY OF THE USSR SHIELDING EXPERIMENT IS DESIRED. DISCUSSIONS WITH USSR SCIENTISTS ARE REQUIRED TO CLARIFY THE NATURE OF THEIR

EXPERIMENTS AND THE POSSIBILITY FOR U.S. PARTICIPATION.
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END ABSTRACTS.

IN THE CASE OF HEATH, THE MID-SHAFT SECTIONS OF FEMUR MAY COME FROM THE BONES SUPPLIED TO HOLTON AND BAYLINK. IN THE CASE OF SIMMONS, THERE ARE NO LONG BONES, ONLY MANDIBLES (WITH TEETH) REQUIRED FROM FLIGHT AND FLIGHT CONTROL RATS. IN THE CASE OF DOWELL ET. AL., IT WOULD BE PREFERABLE IF THE PIECES OF MUSCLE THEY REQUEST NOT BE TAKEN FROM THE MUSCLES REQUESTED BY CASTLEMAN ET. AL., WHO NEED WHOLE MUSCLE.

REGARDING THE TWO VOLUMES ALLOCATED TO U.S. EXPERIMENTS, WE ARE RECOMMENDING THAT BENTON ET. AL., OCCUPY ONE OF THE VOLUMES. WE HAVE STUDIED A DESIGN APPROACH TO INCORPORATE BOTH THE BAKER AND KRIKORIAN INVESTIGATIONS INTO THE OTHER VOLUME, AND IT APPEARS TO BE FEASIBLE. IN THE EVENT THAT ALL THREE ARE SELECTED AND NO ADDITIONAL VOLUME IS AVAILABLE, WE WILL CONTINUE TO DEVELOP THIS PACKAGING DESIGN.

BEST REGARDS,

DAVID L. WINTER, M.D.
NASA DIRECTOR FOR LIFE SCIENCES

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